Production of Value-Added Crops: The Case of High-Oil Corn

U.S. corn producers have so far been relatively slow to devote significant acreage to the production of high-oil corn and other varieties with specialized traits that add value to the commodity output. This reluctance contrasts with the relatively rapid adoption of corn hybrids with specialized input traits.

High-oil corn was expected to serve as a model for how the grain sector would move from bulk commodity-based production to onfarm value-added production. But production involves a number of risks and uncertainties that may have hindered more planting. Further, the returns to high-oil corn appear to be positively correlated with returns to commodity corn and soybeans, suggesting that value-added production may not always insulate producers from the risks associated with commodity agriculture. Producers cite falling high-oil corn premiums relative to conventional corn as a major factor in deciding against growing high-oil corn.

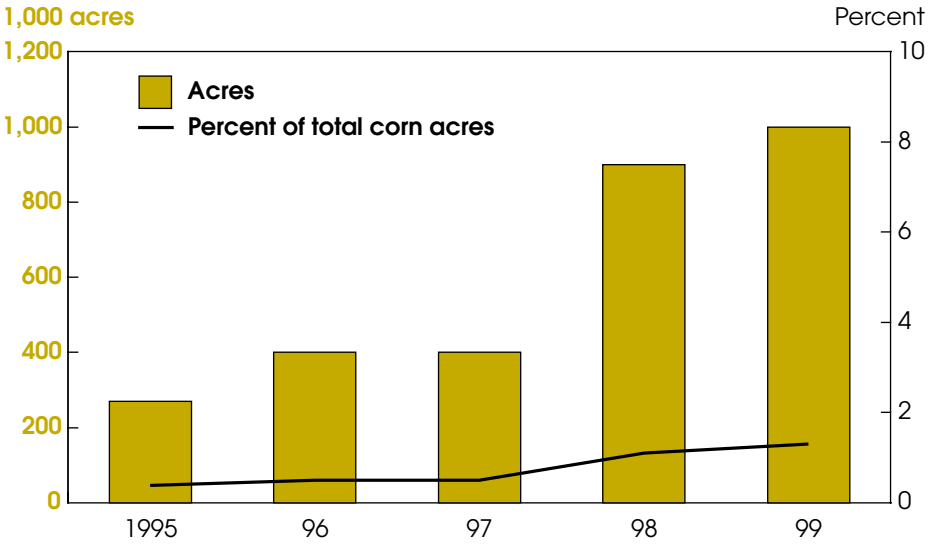
High-oil corn is a variety developed through traditional breeding that contains 6-8 percent oil, compared with about 3.5-4 percent for conventional corn. The higher oil content provides more energy (the energy content of oil is more than twice that of the starch) and can reduce expenditures for fat supplements in livestock feed. High-oil corn has higher average levels of amino acids and crude protein and may improve feed palatability. These attributes contribute added value for livestock feeding.

Production of high-oil corn has expanded since its commercial introduction in 1992, reaching 1 million acres or 1.3 percent of total corn acreage in 1999. Since then, indications are that acreage has leveled out or even declined. But adoption has been substantially less than the herbicide tolerant and Bt corn varieties introduced in 1996 that rose by 1999 to 8 and 26 percent of planted corn acreage, respectively.

In 1998, about half of high-oil corn production was exported and the balance fed to domestic livestock. Production for export occurred primarily under contract. Special arrangements with major grain companies segregated the product and coordinated its movement from farm to elevator, barge, etc. So far, high-oil corn has been used mostly in hog feed. An even greater potential use is in poultry feed, if major companies decide to consider the product and invest in or contract for its production.

Farmers report decreasing returns over time for high-oil corn. One reason has been low prices in commodity markets for substitute products that have reduced what livestock feeders are willing to pay for high-oil corn. A second reason for decreasing returns has been the additional risks of value-added production, such as the need to meet specialized production requirements, and the variable returns based on product attributes achieved.

Plantings of High-Oil Corn Have Increased but Are Still Relatively Small



Based on industry and extension sources.

Economic Research Service, USDA

Examples of New Crop Varieties

Output or value-added traits	Input traits
In production	**In production**
High-oil corn (1-2% of acreage in 1999)—Contains 6-8 % oil compared with 3.5-4 % for conventional corn; increases calorie content when used as feed	**Bt corn** (26% of acreage in 1999)—Produces a bacterial pesticide that controls certain insects
High-lysine corn (<1% of acreage in 1999)—Has increased levels of amino acids	**Herbicide-tolerant corn** (8% acreage in 1999)—Permits use of weed-killing herbicides
High-amylose corn (<1% of acreage in 1999)—Has unique starch characteristics for use in textiles, gum candies, and adhesives	**Herbicide-tolerant soybeans** (56% acreage in 1999)—Permit use of weed-killing herbicides
High-oleic soybeans (<1% of acreage in 1999)—Yield oil with less saturated fat than conventional soybeans, reducing need for hydrogenation	**Bt cotton** (32% of acreage in 1999)—Produces a bacterial pesticide that controls insects
Low-linolenic soybeans (<1% of acreage in 1999)—Produce half the linolenic-acid level of conventional soybeans, reducing need for hydrogenation	**Herbicide-tolerant cotton** (42% acreage in 1999)—Permits use of weed-killing herbicides
In development	**In development**
Low-phytate corn—Decreases the amount of phosphorous in livestock waste, reducing pollution potential	**Herbicide tolerant sugar beets and sugar cane**
High-stearate canola—Oil solidifies at room temperature without hydrogenation; useful for margarines	**Disease resistant corn, potatoes, and other fruits and vegetables**
Colored cotton—Reduces need for dyes	**Crops with frost tolerance, drought tolerance, or greater nitrogen use efficiency**
Higher protein soybeans and cassava	
Rice with higher vitamin A and iron content	
Delayed-ripening tomato	
Wrinkle-resistant cotton	
Bananas with cholera vaccine	

Economic Research Service, USDA

Contrary to many agricultural policy prescriptions, moving into differentiated production may be relatively less attractive during times of farm financial stress due to increased risks and price uncertainties. Fundamentally, a differentiated product must create sufficient expected added value to compensate producers for any additional costs of producing the product. This may not currently be the case for high-oil corn.

Itemizing the Limits & Risks

While industry groups have generally supported innovations such as high-oil corn, farmers' experiences with its production have been mixed. Recent focus group sessions and interviews with Iowa producers have identified a number of factors that may be discouraging plantings of high-oil corn.

Limit on hog feed use—While some high-oil corn in a hog ration improves performance, hog feeders have found that too much high-oil corn causes PSE (pale soft exudative) pork in carcasses, damaging their marketability. This sets an upper limit on the demand for high-oil corn for feed per hog.

Yield risk is greater with high-oil corn because of its pollination method. Unlike most conventional corn, production of high-oil corn requires the intermixed seeding of non-bearing corn pollinators that provide pollen with high-oil genes for the male-sterile corn hybrids. This makes the pollination process riskier than for conventional corn, being more dependent on favorable weather and the performance of the pollinator. Poor pollination results in reduced yields. Further, the addition of the pollinator seeds increases the total seeds planted per acre by about 10 percent so that seed and seeding costs increase relative to those of conventional corn.

Quality risk arises in producing and maintaining the quality of the product so that a price premium may be obtained. To retain quality, high-oil corn must often be dried at a lower temperature than conventional corn, increasing drying costs. Uncertainty is also associated with producing the desired quality. Even if a producer follows recommended production practices, the harvested grain may not meet the buyer's quality standards. In that event, the producer will have to sell the crop as conventional corn despite higher production costs. High-oil corn premiums are usually paid on a sliding scale based on oil content. Hence, variability in oil content translates directly into greater variability in returns compared with conventional corn.

Maintaining the quality of high-oil corn also requires the crop's segregation and separate handling to prevent contamination or mixing with conventional corn. While costs of identity preservation may decline slightly over time as producers learn how to accomplish this task effectively, the time and money necessary to clean grain-handling equipment and segregate the crop are factors producers must consider.

Price risk is associated with poor performance of the associated commodity markets, especially corn, soybeans, and hogs. Low hog prices reduce the value of high-oil corn in livestock production, so users are willing to pay less of a premium for it. Similarly, the lower the price of white grease and soybean meal, the less expensive it is to substitute conventional corn plus white grease and soybean meal for high-oil corn in feed to achieve a given amount of weight gain. Users then reduce the premium they are willing to pay for high-oil corn. Producers can hedge against such relative price risk, but

Risks Faced By Producers of High-Oil Corn
Yield risk—Pollination process is riskier than for conventional corn
Market risk —Premiums for high-oil content may decrease as supply and demand adjust
Quality risk—Variability in oil content or mixing with conventional corn may reduce price premium buyer will pay
Price risk—Prices of substitutes or hogs may drop, reducing demand for high-oil corn
Relationship risk—Buyer may renege on the agreement

hedging involves transaction costs and does not address yield risk or quality risk.

Another aspect of price risk is that quality deductions, such as those for excessive moisture, are on a fixed cents per bushel basis, rather than as a percentage of value. Per bushel deductions mean that both expected deductions and the variability of deductions are higher as a percentage of total expected revenues when the oil premium or the price of conventional corn is lower.

Market risk due to natural adjustments within a relatively new market may be another cause of the declining premiums received for high-oil corn. Buyers may be seeking to learn about the supply situation. As they reduce the premiums, they determine the acres of high-oil corn that producers are willing to plant for a given premium schedule. Provided that the supply at a given price meets or exceeds demand, buyers have an incentive to further reduce the premium the following crop year. This behavior could occur whether or not market power is present on the purchasing side. As more producers plant high-oil corn and supply increases, premiums are likely to fall. If a producer invests in learning to grow high-oil corn, the returns to this investment may decline over time.

Relationship risk is involved in identifying and maintaining a buyer for the value-added product. While some producers may grow high-oil corn for use in their own livestock operations, others must identify a buyer for their product. A producer who plants high-oil corn without first identifying a buyer risks having a crop with no sales outlet. When a producer does identify a buyer in advance, there is risk that the buyer will renege on the agreement by refusing delivery or failing to pay for the crop in a timely manner.

Formal contracts can partially mitigate relationship or buyer risks, but they raise other considerations affecting risks and returns. For example, the precise legal nature of the relationship between producer and contractor may affect the producer's tax liability. Contractual specification of the circumstances under which the contractor may terminate the relationship may be extremely broad, and the contract may require the producer to waive the right to pursue legal action as part of the contract. Regardless of whether a formal contract is signed, producing a value-added crop such as high-oil corn requires investment in learning about production specifics and identity preservation practices, in addition to any specific capital investments that are required. If a producer invests in order to produce for a specific buyer, there is the risk that the buyer will not continue to purchase the product over a long enough period for the farmer to recoup the investment.

Lessons From Adoption Of High-Oil Corn

Under the economic conditions of the past few years, the value added by high-oil corn has decreased, while costs have not. Production of high-oil corn poses additional sources of revenue risk for growers. The case of high-oil corn suggests that the returns for value-added products may be quite closely tied to the performance of the conventional commodity markets when the products are partial substitutes. Thus, differentiated markets may add risks to those found in commodity markets. These conditions may discourage producers from rapidly expanding acreage in differentiated products, particularly during times of farm financial stress. AO

Corinne Alexander (University of California, Davis), Jorge Fernandez-Cornejo (ERS) (202) 694-5537 jorgef@ers.usda.gov, and Rachael E. Goodhue (University of California, Davis)

FOR MORE INFORMATION

Economic Research Service
http://www.ers.usda.gov/publications/aib762/
http://www.ers.usda.gov/publications/agoutlook/mar1999/ao259e.pdf
http://www.ers.usda.gov/publications/agoutlook/apr2000/ao270h.pdf

College of Agricultural, Consumer, and Environmental Sciences of the University of Illinois:
http://web.aces.uiuc.edu/value/factsheets/framehigh_oil_corn.htm
http://web.aces.uiuc.edu/value/factsheets/corn.htm
http://web.aces.uiuc.edu/value/factsheets/soy.htm

National Corn Growers Association
http://www.ncga.com/03world/main/biotechnology.html